

# 1 Fuses and Circuit Breakers

## 1.1.1 Fuses

A frequency converter that works correctly limits the current it can draw from the supply. Still, it is recommended to use fuses and/ or Circuit Breakers on the supply side as protection in case of component break-down inside the frequency converter (first fault).

### NOTE

This is mandatory in order to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

### **⚠ WARNING**

Personnel and property must be protected against the consequence of component break-down internally in the frequency converter.

#### Branch Circuit Protection

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be protected against short-circuit and over-current according to national/international regulations.

### NOTE

The recommendations given do not cover Branch circuit protection for UL!

#### Short-circuit protection:

Danfoss recommends using the fuses/Circuit Breakers listed in 1.1.6 CE Compliance and 1.1.7 UL Compliance to protect service personnel and property in case of component break-down in the frequency converter.

#### Over current protection:

The frequency converter provides overload protection to limit threats to human life, property damage and to avoid fire hazard due to overheating of the cables in the installation. The frequency converter is equipped with an internal over current protection (4-18 Current Limit) that can be used for upstream overload protection (UL-applications excluded). Moreover, fuses or Circuit Breakers can be used to provide the over current protection in the installation. Over current protection must always be carried out according to national regulations.

## 1.1.2 Energy Required to Clearing the Circuit

It is important to choose a fuse/Circuit Breaker with a low  $I^2t$  [ $A^2s$ ]. This parameter is the energy required to clearing and is a measure of the damaging effect on the frequency converter.

Fuses offer better protection of the frequency converter than Circuit Breakers as  $I^2t$  is smaller for fuses.

$I^2t_{aR \text{ fuse}} \ll I^2t_{gG \text{ fuse}} \ll I^2t_{\text{circuit breaker}}$  for the same nominal value

*The fastest clearing is done with an aR fuse (partial range accompanied protection for semiconductors) that is faster than a gG fuse (wide-range general-purpose protection for cables, conductors and wires). Circuit Breakers are slower.*

## 1.1.3 Safely Breaking the Current

Fuses and Circuit Breakers must be capable of safely breaking the current in the event of a short circuit. When a large electric current is interrupted an arc may form and if the breaking capacity of a fuse or circuit breaker is exceeded then it may not be able to extinguish this arc and the current will continue, which might have severe consequences.

This breaking capacity is known as the Short Circuit Current Rating (SCCR).

The prospective short circuit current (PSCC) is the highest electric current which can exist in a particular electrical system under short circuit- and ground fault conditions and is determined by the voltage and impedance of the supply system.

With gG fuses, the SCCR is 100 kA rms (symmetrical) which means that it will be possible to disconnect a PSCC of up to 100 kA rms (symmetrical). The recommended aR fuses and Circuit Breakers have a lower SCCR which means that they will not be able to disconnect a PSCC of that magnitude. The data sheets must be consulted for details.

### NOTE

In general, be aware that your fuse/Circuit Breaker must be capable of handling the PSCC.

### 1.1.4 Fuses and Circuit Breakers

The selection of fuse and/or Circuit Breaker will depend on preferences and on the installation in question. Sometimes it is necessary to combine the two.

#### Fuses

A nonrenewable fuse interrupts excessive current by clearing. Fuses are selected to allow passage of normal current and of excessive current only for short periods. After clearing, the fuse must be replaced.

gG-fuses offer full protection and can be used alone or as electrical branch-fuse.

#### NOTE

aR semi-conductor fuses must never be used as the only protection. Always combine with gG fuses or a Circuit Breaker depending on the prospective current. Alternatively, gRL fuses can be used alone.

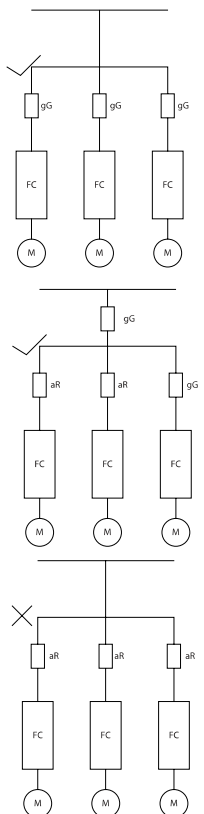


Illustration 1.1 gG Fuses offer Full Protection and can be Used Alone or as Electrical Branch-fuse

#### Circuit Breakers

A Circuit Breaker is an automatically-operated electrical switch that is designed for overload protection. It can be used to interrupt excessive current by disconnecting but it is slower than a nonrenewable fuse. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. When a current is interrupted, an arc is generated. Different techniques are used to extinguish the arc.

#### NOTE

Circuit Breakers should generally not be used as the only protection. There are some Circuit Breakers now, however, that can do the job. Generally, combine with a gG fuse or a bigger Circuit Breaker branch-fuse for the desired protection depending on the prospective current.

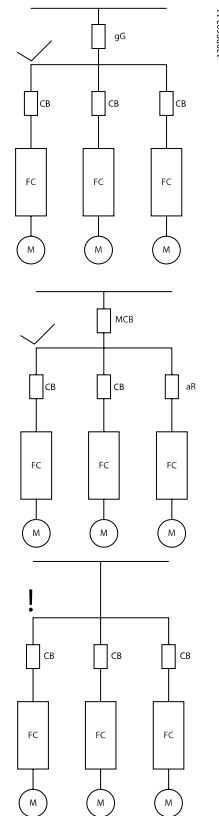


Illustration 1.2 Circuit Breakers should Generally not be used as the Only Protection

1.1.5 Recommendations

**WARNING**

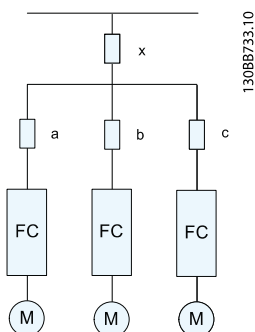
In case of malfunction, not following the recommendation may result in personnel risk and damage to the frequency converter and other equipment.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. For Circuit Breakers, Moeller types have been tested to have a recommendation. Other types of circuit breakers may be used provided they limit the energy into the drive to a level equal to or lower than the Moeller types.

If fuses/Circuit Breakers according to recommendations are chosen, possible damages on the frequency converter will mainly be limited to damages inside the unit.

**NOTE**

Following the recommendations puts the direct fuses/Circuit Breaker in place (a, b, c... in figure below). It does NOT make up for considering combined protection or branch circuit protection (see x in illustration below).



**NOTE**

The dimensions in *Table 1.2* are for an ambient temperature at 20C. At an ambient temperature at 40C, use *Recommended Max. fuse* for gR/aR.

### 1.1.6 CE Compliance

Fuses or Circuit Breakers are mandatory to comply with IEC 60364. Danfoss recommend using a selection of the following.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, or 480V, or 500V, or 600V depending on the drive voltage rating. With the proper fusing the drive short circuit current rating (SCCR) is 100,000 Arms.

Enclosure	FC 300 Power	FC 100/200 Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]	[kW]			Moeller	[A]
A1	0.25-1.5	-	gG-10	gG-25	PKZM0-16	16
A2	0.25-2.2	0.25-2.2	gG-10 (0.25-1.5) gG-16 (2.2)	gG-25	PKZM0-25	25
A3	3.0-3.7	3.0-3.7	gG-16 (3) gG-20 (3.7)	gG-32	PKZM0-25	25
B3	5.5	5.5-11	gG-25	gG-63	PKZM4-50	50
B4	7.5-15	15-18	gG-32 (7.5) gG-50 (11) gG-63 (15)	gG-125	NZMB1-A100	100
C3	18.5-22	22-30	gG-80 (18.5) aR-125 (22)	gG-150 (18.5) aR-160 (22)	NZMB2-A200	150
C4	30-37	37-45	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250
A4	0.25-2.2	0.25-2.2	gG-10 (0.25-1.5) gG-16 (2.2)	gG-32	PKZM0-25	25
A5	0.25-3.7	0.25-3.7	gG-10 (0.25-1.5) gG-16 (2.2-3) gG-20 (3.7)	gG-32	PKZM0-25	25
B1	5.5-7.5	5.5-11	gG-25 (5.5) gG-32 (7.5)	gG-80	PKZM4-63	63
B2	11	15	gG-50	gG-100	NZMB1-A100	100
C1	15-22	18.5-30	gG-63 (15) gG-80 (18.5) gG-100 (22)	gG-160 (15-18.5) aR-160 (22)	NZMB2-A200	160
C2	30-37	37-45	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250

**Table 1.1 200-240V, Frame Sizes A, B, and C**

Enclosure	FC 300 Power	FC 100/200 Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]	[kW]			Moeller	[A]
A1	0.37-1.5	-	gG-10	gG-25	PKZM0-16	16
A2	0.37-4.0	1.1-4.0	gG-10 (0.37-3) gG-16 (4)	gG-25	PKZM0-25	25
A3	5.5-7.5	5.5-7.5	gG-16	gG-32	PKZM0-25	25
B3	11-15	11-18	gG-40	gG-63	PKZM4-50	50
B4	18.5-30	22-37	gG-50 (18.5) gG-63 (22) gG-80 (30)	gG-125	NZMB1-A100	100
C3	37-45	45-55	gG-100 (37) gG-160 (45)	gG-150 (37) gG-160 (45)	NZMB2-A200	150
C4	55-75	75-90	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250
A4	0.37-4	1.1-4.0	gG-10 (0.37-3) gG-16 (4)	gG-32	PKZM0-25	25
A5	0.37-7.5	1.1-7.5	gG-10 (0.37-3) gG-16 (4-7.5)	gG-32	PKZM0-25	25
B1	11-15	11-18.5	gG-40	gG-80	PKZM4-63	63
B2	18.5-22	22-30	gG-50 (18.5) gG-63 (22)	gG-100	NZMB1-A100	100
C1	30-45	37-55	gG-80 (30) gG-100 (37) gG-160 (45)	gG-160	NZMB2-A200	160
C2	55-75	75-90	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250
D	90-200	110-250	gG-300 (90) gG-350 (110) gG-400 (132) gG-500 (160) gG-630 (200)	gG-300 (90) gG-350 (110) gG-400 (132) gG-500 (160) gG-630 (200)	-	-
E	250-400	315-450	aR-700 (250) aR-900 (315-400)	aR-700 (250) aR-900 (315-400)	-	-
F	450-800	-	aR-1600 (450-500) aR-2000 (560-630) aR-2500 (710-800)	aR-1600 (450-500) aR-2000 (560-630) aR-2500 (710-800)	-	-

Table 1.2 380-500V, Frame Sizes A, B, C, D, E, and F

Enclosure	FC 300 Power	FC 100/200 Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]	[kW]			Moeller	[A]
A2	0-75-4.0	1.1-4.0	gG-10	gG-25	PKZM0-25	25
A3	5.5-7.5	5.5-7.5	gG-10 (5.5) gG-16 (7.5)	gG-32	PKZM0-25	25
B3	11-15	11-18.5	gG-25 (11) gG-32 (15)	gG-63	PKZM4-50	50
B4	18.5-30	22-37	gG-40 (18.5) gG-50 (22) gG-63 (30)	gG-125	NZMB1-A100	100
C3	37-45	45-55	gG-63 (37) gG-100 (45)	gG-150	NZMB2-A200	150
C4	55-75	75-90	aR-160 (55) aR-200 (75)	aR-250	NZMB2-A250	250
A5	0.75-7.5	1.1-7.5	gG-10 (0.75-5.5) gG-16 (7.5)	gG-32	PKZM0-25	25
B1	11-18	11-18	gG-25 (11) gG-32 (15) gG-40 (18.5)	gG-80	PKZM4-63	63
B2	22-30	22-30	gG-50 (22) gG-63 (30)	gG-100	NZMB1-A100	100
C1	37-55	37-55	gG-63 (37) gG-100 (45) aR-160 (55)	gG-160 (37-45) aR-250 (55)	NZMB2-A200	160
C2	75	75-90	aR-200 (75)	aR-250	NZMB2-A250	250

Table 1.3 525-600V, Frame Sizes A, B, and C

Enclosure	FC 300 Power	FC 100/200 Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]	[kW]			Moeller	[A]
B2	11 15 18 22	22-30	gG-25 (11) gG-32 (15) gG-32 (18) gG-40 (22)	gG-63	-	-
C2	30 37 45 55 75	75-90	gG-63 (30) gG-63 (37) gG-80 (45) gG-100 (55) gG-125 (75)	gG-80 (30) gG-100 (37) gG-125 (45) gG-160 (55-75)	-	-
D	37-315	-	gG-125 (37) gG-160 (45) gG-200 (55-75) aR-250 (90) aR-315 (110) aR-350 (132-160) aR-400 (200) aR-500 (250) aR-550 (315)	gG-125 (37) gG-160 (45) gG-200 (55-75) aR-250 (90) aR-315 (110) aR-350 (132-160) aR-400 (200) aR-500 (250) aR-550 (315)	-	-
E	355-560	-	aR-700 (355-400) aR-900 (500-560)	aR-700 (355-400) aR-900 (500-560)	-	-
F	630-1200	-	aR-1600 (630-900) aR-2000 (1000) aR-2500 (1200)	aR-1600 (630-900) aR-2000 (1000) aR-2500 (1200)	-	-

Table 1.4 525-690V, Frame Sizes B, C, D, E, and F

### 1.1.7 UL Compliance

Fuses or Circuit Breakers are mandatory to comply with NEC 2009. We recommend using a selection of the following

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, or 480V, or 500V, or 600V depending on the drive voltage rating. With the proper fusing the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

FC 300 Power	FC 100/200 Power	Recommended max. fuse					
		Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	[kW]	Type RK1 <sup>1)</sup>	Type J	Type T	Type CC	Type CC	Type CC
0.25-0.37	0.25-0.37	KTN-R-05	JKS-05	JJN-05	FNQ-R-5	KTK-R-5	LP-CC-5
0.55-1.1	0.55-1.1	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.5	1.5	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
2.2	2.2	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
3.0	3.0	KTN-R-25	JKS-25	JJN-25	FNQ-R-25	KTK-R-25	LP-CC-25
3.7	3.7	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
5.5	5.5-7.5	KTN-R-50	KS-50	JJN-50	-	-	-
7.5	11	KTN-R-60	JKS-60	JJN-60	-	-	-
11	15	KTN-R-80	JKS-80	JJN-80	-	-	-
15-18.5	18.5-22	KTN-R-125	JKS-125	JJN-125	-	-	-
22	30	KTN-R-150	JKS-150	JJN-150	-	-	-
30	37	KTN-R-200	JKS-200	JJN-200	-	-	-
37	45	KTN-R-250	JKS-250	JJN-250	-	-	-

Table 1.5 200-240V, Frame Sizes A, B, and C

FC 300 Power	FC 100/200 Power	Recommended max. fuse			
		SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	[kW]	Type RK1	Type RK1	Type CC	Type RK1 <sup>3)</sup>
0.25-0.37	0.25-0.37	5017906-005	KLN-R-05	ATM-R-05	A2K-05-R
0.55-1.1	0.55-1.1	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R
1.5	1.5	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R
2.2	2.2	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R
3.0	3.0	5017906-025	KLN-R-25	ATM-R-25	A2K-25-R
3.7	3.7	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R
5.5	5.5-7.5	5014006-050	KLN-R-50	-	A2K-50-R
7.5	11	5014006-063	KLN-R-60	-	A2K-60-R
11	15	5014006-080	KLN-R-80	-	A2K-80-R
15-18.5	18.5-22	2028220-125	KLN-R-125	-	A2K-125-R
22	30	2028220-150	KLN-R-150	-	A2K-150-R
30	37	2028220-200	KLN-R-200	-	A2K-200-R
37	45	2028220-250	KLN-R-250	-	A2K-250-R

Table 1.6 200-240V, Frame Sizes A, B, and C

FC 300	FC 100/200	Recommended max. fuse			
		Bussmann	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	[kW]	Type JFHR2 <sup>2)</sup>	JFHR2	JFHR2 <sup>4)</sup>	J
0.25-0.37	0.25-0.37	FWX-5	-	-	HSJ-6
0.55-1.1	0.55-1.1	FWX-10	-	-	HSJ-10
1.5	1.5	FWX-15	-	-	HSJ-15
2.2	2.2	FWX-20	-	-	HSJ-20
3.0	3.0	FWX-25	-	-	HSJ-25
3.7	3.7	FWX-30	-	-	HSJ-30
5.5	5.5-7.5	FWX-50	-	-	HSJ-50
7.5	11	FWX-60	-	-	HSJ-60
11	15	FWX-80	-	-	HSJ-80
15-18.5	18.5-22	FWX-125	-	-	HSJ-125
22	30	FWX-150	L25S-150	A25X-150	HSJ-150
30	37	FWX-200	L25S-200	A25X-200	HSJ-200
37	45	FWX-250	L25S-250	A25X-250	HSJ-250

**Table 1.7 200-240V, Frame Sizes A, B, and C**

- 1) KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.
- 2) FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.
- 3) A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.
- 4) A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

FC 300	FC 102/202	Recommended max. fuse					
		Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
0.37-1.1	-	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
1.5-2.2	1.1-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3	3	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4	4	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	11	KTS-R-40	JKS-40	JJS-40	-	-	-
15	15	KTS-R-50	JKS-50	JJS-50	-	-	-
18	22	KTS-R-60	JKS-60	JJS-60	-	-	-
22	30	KTS-R-80	JKS-80	JJS-80	-	-	-
30	37	KTS-R-100	JKS-100	JJS-100	-	-	-
37	45	KTS-R-125	JKS-125	JJS-125	-	-	-
45	55	KTS-R-150	JKS-150	JJS-150	-	-	-
55	75	KTS-R-200	JKS-200	JJS-200	-	-	-
75	90	KTS-R-250	JKS-250	JJS-250	-	-	-

**Table 1.8 380-500V, Frame Sizes A, B, and C**



FC 302	FC 102/202	Recommended max. fuse			
		SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	[kW]	Type RK1	Type RK1	Type CC	Type RK1
0.37-1.1	-	5017906-006	KLS-R-6	ATM-R-6	A6K-6-R
1.5-2.2	1.1-2.2	5017906-010	KLS-R-10	ATM-R-10	A6K-10-R
3	3	5017906-016	KLS-R-15	ATM-R-15	A6K-15-R
4	4	5017906-020	KLS-R-20	ATM-R-20	A6K-20-R
5.5	5.5	5017906-025	KLS-R-25	ATM-R-25	A6K-25-R
7.5	7.5	5012406-032	KLS-R-30	ATM-R-30	A6K-30-R
11	11	5014006-040	KLS-R-40	-	A6K-40-R
15	15	5014006-050	KLS-R-50	-	A6K-50-R
18	22	5014006-063	KLS-R-60	-	A6K-60-R
22	30	2028220-100	KLS-R-80	-	A6K-80-R
30	37	2028220-125	KLS-R-100	-	A6K-100-R
37	45	2028220-125	KLS-R-125	-	A6K-125-R
45	55	2028220-160	KLS-R-150	-	A6K-150-R
55	75	2028220-200	KLS-R-200	-	A6K-200-R
75	90	2028220-250	KLS-R-250	-	A6K-250-R

Table 1.9 380-500V, Frame Sizes A, B, and C

FC 302	FC 102/202	Recommended max. fuse			
		Bussmann	Ferraz- Shawmut	Ferraz- Shawmut	Littel fuse
[kW]	[kW]	JFHR2	J	JFHR2 <sup>1)</sup>	JFHR2
0.37-1.1	-	FWH-6	HSJ-6	-	-
1.5-2.2	1.1-2.2	FWH-10	HSJ-10	-	-
3	3	FWH-15	HSJ-15	-	-
4	4	FWH-20	HSJ-20	-	-
5.5	5.5	FWH-25	HSJ-25	-	-
7.5	7.5	FWH-30	HSJ-30	-	-
11	11	FWH-40	HSJ-40	-	-
15	15	FWH-50	HSJ-50	-	-
18	22	FWH-60	HSJ-60	-	-
22	30	FWH-80	HSJ-80	-	-
30	37	FWH-100	HSJ-100	-	-
37	45	FWH-125	HSJ-125	-	-
45	55	FWH-150	HSJ-150	-	-
55	75	FWH-200	HSJ-200	A50-P-225	L50-S-225
75	90	FWH-250	HSJ-250	A50-P-250	L50-S-250

Table 1.10 380-500V, frame sizes A, B, and C

1) Ferraz-Shawmut A50QS fuses may substitute for A50P fuses.

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FC 302	FC 102/202	Recommended max. fuse					
		Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
0.75-1.1	0.75-1.1	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
1.5-2.2	1.5-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3	3	KTS-R15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4	4	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	11-15	KTS-R-35	JKS-35	JJS-35	-	-	-
15	18	KTS-R-45	JKS-45	JJS-45	-	-	-
18	22	KTS-R-50	JKS-50	JJS-50	-	-	-
22	30	KTS-R-60	JKS-60	JJS-60	-	-	-
30	37	KTS-R-80	JKS-80	JJS-80	-	-	-
37	45	KTS-R-100	JKS-100	JJS-100	-	-	-
45	55	KTS-R-125	JKS-125	JJS-125	-	-	-
55	75	KTS-R-150	JKS-150	JJS-150	-	-	-
75	90	KTS-R-175	JKS-175	JJS-175	-	-	-

Table 1.11 525-600V, Frame Sizes A, B, and C

FC 302	FC 102/202	Recommended max. fuse			
		SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	[kW]	Type RK1	Type RK1	Type RK1	J
0.75-1.1	0.75-1.1	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.5-2.2	1.5-2.2	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
3	3	5017906-016	KLS-R-015	A6K-15-R	HSJ-15
4	4	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
5.5	5.5	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
7.5	7.5	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
11	11-15	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
15	18	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
18	22	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
22	30	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
30	37	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
37	45	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
45	55	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
55	75	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
75	90	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 1.12 525-600V, Frame Sizes A, B, and C

1) 170M fuses shown from Bussmann use the -/80 visual indicator. -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.

FC 302 [kW]	FC 100/200 [kW]	Max. prefuse	Recommended max. fuse						
			Bussmann E52273 RK1/JDDZ	Bussmann E4273 J/JDDZ	Bussmann E4273 T/JDDZ	SIBA E180276 RK1/JDDZ	LittellFuse E81895 RK1/JDDZ	Ferraz-Shawmut E163267/E2137 RK1/JDDZ	Ferraz-Shawmut E2137 J/HSJ
11	11-15	30 A	KTS-R-30	JKS-30	JKJS-30	5017906-030	KLS-R-030	A6K-30-R	HST-30
15-18.5	22	45 A	KTS-R-45	JKS-45	JJS-45	5014006-050	KLS-R-045	A6K-45-R	HST-45
22	30	60 A	KTS-R-60	JKS-60	JJS-60	5014006-063	KLS-R-060	A6K-60-R	HST-60
30	37	80 A	KTS-R-80	JKS-80	JJS-80	5014006-080	KLS-R-075	A6K-80-R	HST-80
37	45	90 A	KTS-R-90	JKS-90	JJS-90	5014006-100	KLS-R-090	A6K-90-R	HST-90
45	55	100 A	KTS-R-100	JKS-100	JJS-100	5014006-100	KLS-R-100	A6K-100-R	HST-100
55	75	125 A	KTS-R-125	JKS-125	JJS-125	2028220-125	KLS-150	A6K-125-R	HST-125
75	90	150 A	KTS-R-150	JKS-150	JJS-150	2028220-150	KLS-175	A6K-150-R	HST-150

\* UL compliance only 525-600 V

Table 1.13 525-690V\*, Frame Sizes B and C

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate External Bussmann PN	Alternate External Bussmann PN	Alternate External Siba PN	Alternate External Littlefuse PN	Alternate External Ferraz-Shawmut PN
90	170M3017	315A, 700V	170M3018	FWH-300	JJS-300	2028220-315	L50-S-300	A50-P-300
110	170M3018	350A, 700V	170M3018	FWH-350	JJS-350	2028220-315	L50-S-350	A50-P-350
132	170M4012	400A, 700V	170M4016	FWH-400	JJS-400	206xx32-400	L50-S-400	A50-P-400
160	170M4014	500A, 700V	170M4016	FWH-500	JJS-500	206xx32-500	L50-S-500	A50-P-500
200	170M4016	630A, 700V	170M4016	FWH-600	JJS-600	206xx32-600	L50-S-600	A50-P-600

Table 1.14 380-480/500V, Frame Size D, Line Fuse

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate External Siba PN	Alternate External Ferraz-Shawmut PN
250	170M4017	700A, 700V	170M4017	20 610 32.700	6.9URD31D08A0700
315	170M6013	900A, 700V	170M6013	22 610 32.900	6.9URD33D08A0900
355	170M6013	900A, 700V	170M6013	22 610 32.900	6.9URD33D08A0900
400	170M6013	900A, 700V	170M6013	22 610 32.900	6.9URD33D08A0900

Table 1.15 380-480/500V, Frame Size E, Line Fuse

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate Siba PN
450	170M7081	1600A, 700V	170M7082	20 695 32.1600
500	170M7081	1600A, 700V	170M7082	20 695 32.1600
560	170M7082	2000A, 700V	170M7082	20 695 32.2000
630	170M7082	2000A, 700V	170M7082	20 695 32.2000
710	170M7083	2500A, 700V	170M7083	20 695 32.2500
800	170M7083	2500A, 700V	170M7083	20 695 32.2500

Table 1.16 380-480/500V, Frame Size F, Line Fuse

FC 302 [kW]	Drive Internal Bussmann PN	Rating	Alternate Siba PN
450	170M8611	1100A, 1000V	20 781 32.1000
500	170M8611	1100A, 1000V	20 781 32.1000
560	170M6467	1400A, 700V	20 681 32.1400
630	170M6467	1400A, 700V	20 681 32.1400
710	170M8611	1100A, 1000V	20 781 32.1000
800	170M6467	1400A, 700V	20 681 32.1400

Table 1.17 380-480/500V, Frame Size F, Inverter Module DC Link Fuses

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate External Siba PN	Alternate External Ferraz-Shawmut PN
37	170M3013	125A, 700V	170M3015	2061032,125	6.9URD30D08A0125
45	170M3014	160A, 700V	170M3015	2061032,16	6.9URD30D08A0160
55	170M3015	200A, 700V	170M3015	2061032,2	6.9URD30D08A0200
75	170M3015	200A, 700V	170M3015	2061032,2	6.9URD30D08A0200
90	170M3016	250A, 700V	170M3018	2061032,25	6.9URD30D08A0250
110	170M3017	315A, 700V	170M3018	2061032,315	6.9URD30D08A0315
132	170M3018	350A, 700V	170M3018	2061032,35	6.9URD30D08A0350
160	170M4011	350A, 700V	170M5011	2061032,35	6.9URD30D08A0350
200	170M4012	400A, 700V	170M5011	2061032,4	6.9URD30D08A0400
250	170M4014	500A, 700V	170M5011	2061032,5	6.9URD30D08A0500
315	170M5011	550A, 700V	170M5011	2062032,55	6.9URD32D08A0550

Table 1.18 525-690V, Frame Size D, Line Fuse

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate External Siba PN	Alternate External Ferraz-Shawmut PN
355	170M4017	700A, 700V	170M4017	20 610 32.700	6.9URD31D08A0700
400	170M4017	700A, 700V	170M4017	20 610 32.700	6.9URD31D08A0700
500	170M6013	900A, 700V	170M6013	22 610 32.900	6.9URD33D08A0900
560	170M6013	900A, 700V	170M6013	22 610 32.900	6.9URD33D08A0900

Table 1.19 525-690V, Frame Size E, Line Fuse

FC 302 [kW]	Recommended Drive External Fuse Bussmann PN	Rating	Drive Internal Option Bussmann PN	Alternate Siba PN
630	170M7081	1600A, 700V	170M7082	20 695 32.1600
710	170M7081	1600A, 700V	170M7082	20 695 32.1600
800	170M7081	1600A, 700V	170M7082	20 695 32.1600
900	170M7081	1600A, 700V	170M7082	20 695 32.1600
1000	170M7082	2000A, 700V	170M7082	20 695 32.2000
1200	170M7083	2500A, 700V	170M7083	20 695 32.2500

Table 1.20 525-690V, Frame Size F, Line Fuse

FC 302 [kW]	Drive Internal Bussmann PN	Rating	Alternate Siba PN
630	170M8611	1100A, 1000V	20 781 32.1000
710	170M8611	1100A, 1000V	20 781 32.1000
800	170M8611	1100A, 1000V	20 781 32.1000
900	170M8611	1100A, 1000V	20 781 32.1000
1000	170M8611	1100A, 1000V	20 781 32.1000
1200	170M8611	1100A, 1000V	20 781 32.1000

Table 1.21 525-690V, Frame Size F, Inverter Module DC Link Fuses

\*170M fuses from Bussmann shown use the -/80 visual indicator, -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted for external use

\*\*Any minimum 500V UL listed fuse with associated current rating may be used to meet UL requirements.